Agricultural Engineering and Technology for Food Security and Sustainable Agriculture in Thailand

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Introduction

Agricultural and Food Development Goals

Agricultural R&D for Food Security and Sustainability

Conclusion
Thailand is an agricultural country

- 46.6% of population engage in agricultural sector.
- The world largest rice exporter
- 10.1% of GNP

Map showing Thailand and its major cities, including Chiang Mai and Bangkok. A pie chart indicates: Unclassified 27.8%, Farm holding 40.9%, Forest 31.4%.
Contribution for agricultural sector

- Fishery: 22.4%
- Crops: 61.8%
- Live stock: 15.6%
- Forest: 0.02%
- Other: 0.18%

- Rice: 49.8%
- Field crops: 21.5%
- Horticulture crops: 21.2%
- Other crops: 7.5%
2. Agricultural and Food Development Goals

The Tenth National Economic and Social Development Plan (2007 – 2011)

The Plan will focus on ‘human’ as center of development efforts.
Three main elements are accentuated: sufficiency economic, sustainable development, long-term planning vision spanning the next 20 years to provide ‘change management’.
The Government policies and strategies relate to agriculture as following:

- Promote agricultural development based on the “New Theory” as an important alternative for small farmers; at the same time, expand opportunities for product development and improve product quality through the use of technology, management and access to markets;
-Local Community Products will be supported so that they are recognized by consumers as quality products in line with their market potential, whether at the regional, national or export levels;
	his can be accomplished through the establishment of an integrated project management system that will improve technology and management as well as provide market support;
- Small and Medium Enterprises (SMEs): make use of the public-private sector alliance to increase the effectiveness of, and thereby strengthen, all SMEs through science and technology and management; in addition, special importance will be given to those SMEs that make use of intellectual property;
-Promote energy efficiency, energy saving, the development and use of alternative energy, the survey and development of domestic and international sources of energy-including the joint development areas with neighboring countries-the use clean energy, and appropriate price structure for energy and restructuring of the management of energy affairs by ensuring that there is a clear division between energy policy-making and regulation, and promoting long-term competition in the energy business as well as research and development of alternative energy.
3. Agricultural R&D for Food Security and Sustainability

The research and development of agricultural technology in Thailand for food security and agricultural sustainable are:
3.1 Rice Cultivation by Stubble-Lodge Ratooning Rice

This method utilizes the rice stubbles from the previous harvest, allowing the apical buds on the stubbles to develop into full-grown plants which would later flower and produce seeds for another harvest. There are many positive effects of this method. There is neither the need to burn the paddy fields, re-till the soil, nor buy new seeds. It also reduces the amount of water needed and other production factors.
3.2 Rice Combine Harvester

The role of rice combine harvester in Thailand was considered to be on economic, social and agricultural production systems.

For economic aspect, the labor shortage in harvesting, the need in quality improvement of rice and cost reduction that lead to the utilization of rice combine harvester.
For social aspect, due to labour migration most available labour were the old people and children.

For agricultural production system, the rice combing harvester was necessary in timely harvesting for upland crop planting as a second crop after rice. In term of post-harvest loss, the use of combine harvester loss can be reducing when compared with traditional method.
3.3 Grain Dryer

Drying of wet paddy is done by the miller or by the collector using only dryer or both mechanical dryer and sun drying floor. Types of paddy dryer used in Thailand are cross flow, mixed flow, fluidized bed and rotary dryer.

Head rice yield obtained from those dryers are higher compared to the sun drying floor method. Source of fuel used for generating hot air for drying is rice hull, and is mostly direct fire from the furnace.
3.4 Biomass energy

According to a recent study on Assessment of Sustainable National Biomass Resource Potential for Thailand, many potential biomass sources were identified, including agricultural and wood residues, wood fuels, new plantations, waste water from livestock farms and industries, and municipal solid wastes.
Biomass Potential

Major agricultural residues in 2002/2003

- **Rice husk**: 5.5 M tons/yr
  - Power potential: 560 MW

- **Bagasse**: 20 M tons/yr
  - Power potential: 1400 MW

- **Rhizomes**: 1.6 M tons/yr
  - Power potential: 110 MW
Rhizomes
Biomass are utilized as fuel for industrial heat.
Gasifier
3.4.1 Biogas - In addition to biomass residues, wastewater containing organic matters from livestock farms and industries has increasingly been used as a potential source of biomass energy. Biogas systems using anaerobic digestion techniques such as Up flow Anaerobic Sludge Blanket (UASB) and Fixed Film technology have substantially been established especially for pig farms and food processing industries. In general, the biogas systems can be locally produced and installed.
The biogas technology has been rapidly and widely accepted particularly in both large and small-sized livestock farms chiefly because the production of biogas in the livestock farms helps alleviate not only the pollution problems but also the energy cost by substituting the on-site use of fuel oil, LPG or electricity.
The production potential of biogas from industrial wastewater from palm oil industries, tapioca starch industries, food processing industries, and slaughter industries is also significant. It was estimated that in Thailand a total of 440 Mm$^3$ of biogas could potentially be produced from wastewater from such factories.
Korat Waste to Energy - biogas

- Uses waste water from cassava to make methane
- Produces gas for all factory heat (30 MW thermal) + 3 MW of electricity
- Earns high market returns
- Developer estimates 300 MW from waste water + 800 MW from wet cake
3.4.2 *Ethanol* - The use of agricultural products, such as cassava and molasses, for ethanol production has been given particular attention since ethanol, which is 99.5% pure alcohol by volume, can replace the use of Methyl Tertiary Butyl Ether (MTBE), a fuel additive, which takes a long time to degrade. Each year Thailand spends more than 2 billion baht on MTBE import. Therefore, the use of domestically produced ethanol can contribute to foreign currency saving as well as mitigation of pollution problems resulting from fossil fuel combustion.
3.4.3 Gasohol - Gasohol is an alternative fuel for vehicles. It is a mixture of ethanol and regular gasoline at the ratio 1:9. The properties of derived gasohol are the same as Octane 95 gasoline. However, the use of gasohol will not only reduce oil consumption and air pollution from vehicle exhaust but also help farmers through the purchase of agricultural products, i.e. sugarcane and cassava.
Gasohol Strategic Plan

Phase I
MTBE replacement

Formulated policy on fade out MTBE in ULG 95 and promote Gasohol 91 in some areas

Phase II
Gasohol Mandate

- Spec. of Gasohol 95 & 91
- Emission test on using Gasohol 95
- Defined gasohol use in Spec. of new vehicle procurement
- Requested governments’ vehicles to refill gasohol

Formulate policy on utilizing High Performance Vehicles for E10 and FFV

- Enforced government fleets use Gasohol
- Gas stations in govern. must sell Gasohol

Ethanol
- 1.0 mill. lts /d
- 3.0 mill. lts /d

2004 2005 2006 2007 2008 2009 2010 2011
3.4.4 Biodiesel or Ester - Biodiesel, or ester, another alternative fuel for vehicles, can be produced from oil plants such as coconut, soy bean, palm and sunflower via a chemical process (Transesterification or Alcoholysis), using alkaline as a catalyst to transform fatty acid into ester or biodiesel, which has similar properties to those of diesel oil.
Biodiesel Strategic Plan

2004 2005 2006 2007 2008 2009 2010 2011

- Community based Biodiesel Pilot Project Development
- Biodiesel Strategic Plan
- Biodiesel Mandate 10% Blend
  - Phase I: Specified areas
  - Phase II: Whole country
- Incentive (Biodiesel Community base)
- Prod. Cap. 4.0 mill. lt/d
- Specification of B100 & B5, B10
- Industrial based Biodiesel Development
- Research Demonstration
Biodiesel : Business Model

- Blending Facilities
- Farmers 60,000 Rai
- Business Feasibility
- Biodiesel Plant
- Extraction Plant
- Farmers 60,000 Rai
- Value-added

100,000 Liters/day

Will produce in the 4th year and last 21 years

Glycerin
Oleochemical
Vitamin A,E

Biodiesel Complex
Biofuels were developed as part of plans to limit and reduce greenhouse gas emissions, held responsible for global warming, but since they take up land that would otherwise be used for food production, they have been increasingly blamed for soaring food prices.
3.5.1 Solar dryer - The solar dryer in Thailand was employed many years ago but it has not been disseminated well due to lacking of technology transfer to farmers. In addition, most research work has been focused on industrial scale with high capital cost, which obstructs most farmers who have low capital income. There are a number of solar dryer projects in Thailand at present. Some of these projects are as follow:
Greenhouse dryer
Solar Tunnel Dryer for Agricultural Products Combined with Biomass Gasifier

1. Blower
2. Butterfly Valve
3. Orifice Plate & Manometer
4. Downdraft Gasifier
5. Cyclone Filter
6. Solar Tunnel Dryer
Solar Dryer Combined with Biogas
Wind Energy Potential Map

Average speed 4.4 - 6.4 m/sec

Power Potential 1,600 MW

Power Classes:
- 1.1
- 1.2
- 1.3
- 1.4
- 2
- 3
- 4
- 5
- 6
- 7

ANUAL
Conclusion

Actions taken to minimize the cause of climate change benefit the world. Reducing greenhouse gas emissions must prioritize mitigation measures in the energy sector, which includes less dependence on fossil fuels and moving increasingly towards renewable energy alternatives as well as more efficient energy.